ANC08FA053
Changes to Brief of Accident
July 7, 2015

BRIEF NARRATIVE

The commercial pilot was on a Part 135 passenger flight transporting telecommunication technicians to remote sites. A technician was left at one site, and when the helicopter did not return, he contacted his employer. His employer contacted the helicopter operator. Unable to make contact with the helicopter, the operator contacted the FAA, and reported the helicopter overdue. A search for the helicopter was initiated based on a position report from the helicopter's onboard commercial satellite tracking system. A snowstorm in the search area precluded the use of aircraft in the search, and ground searchers were unsuccessful.

A State Trooper helicopter found the crash site the next morning when the weather improved. The pilot and three passengers were found dead; the fourth passenger, the minor stepson of one of the technicians, had head injuries and hypothermia. According to the operator and survivor, after transporting the first technician, the helicopter landed at a rest area near the highway and picked up another technician and his stepson prior to going to the next site. The stepson was in the left front seat, and the three technicians were in the rear seats. The destination site was about 2.5 miles from the rest area across a ravine. A motorist on the highway saw the helicopter depart from the rest area, and then make a steep descent into a ravine. He said he thought the descent was unusual, but he did not see any impact, and thought the helicopter was working in the ravine. He said the visibility was about 2 miles, and it was snowing lightly.

The helicopter impacted terrain approximately in a level attitude in a near vertical descent, about three-quarters of a mile from the rest area. The terrain at the accident site was rough and uneven, covered with trees, high brush, and snow. The accident flight lasted less than 2 minutes. The surviving front seat passenger recalled the liftoff and departure, then said he felt like he was falling, and that the pilot told everyone to "hold on we're going to crash."

The main rotor blades remained attached to the rotor head; two of the blades were resting on the ground, and the third blade was suspended over the ravine. The uncut brush surrounding the two blades resting on the ground and the downward chordwise bend of the suspended blade were consistent with low rotor rpm at final impact.

Examination of the helicopter’s engine and drive train revealed damage signatures indicative of an overtorque event. These signatures included a 7 millimeter misalignment of the engine’s module 5 drive nut and torsional damage (twisting) of the engine-to-transmission driveshaft, which shortened the driveshaft, allowing the splines at the aft end of the shaft to disengage, disconnecting the engine from the main transmission. The module 5 drive nut misalignment was consistent with the engine free turbine producing power at the time of the drive nut overtorque. The direction of rotational smearing damage observed on a portion of the

splines was indicative of the engine continuing to provide power for a short time after the driveshaft twisted and shortened. The directionality of the driveshaft twisting was consistent with an opposing torque load forward (on the transmission side) of the driveshaft, which could have resulted from a main transmission seizure or a main rotor impact event. Disassembly and examination of the main transmission revealed no evidence of a seizure. Therefore, the overtorque likely resulted from one or more main rotor blade strikes occurring while the engine was powering the main rotor system. Further, the overtorque damage likely occurred before the helicopter's final impact in the ravine because the low rotor rpm signatures observed at the accident site indicated that the engine was not powering the main rotor system and that the rotational energy in the system had been significantly dissipated before that impact.

The helicopter's main rotor blades did not exhibit the extensive damage typically seen when powered blades impact terrain (such as fragmentation, twisting, and severe leading-edge damage). However, the outboard sections of the blades did exhibit leading-edge dents and chordwise scratches. Thus, the blades likely impacted relatively soft objects, such as a snow bank or brush, which resulted in the overtorque signatures found on the module 5 drive nut and the engine-to-transmission driveshaft without significant destructive damage to the blades. About 2 months after the accident, investigators searched along the route of flight and found no evidence of a main rotor blade strike (such as ground scars or damaged vegetation); any evidence of impact likely had been obscured by that time.

The engine also showed evidence of an overspeed. Following the overtorque, the sudden disconnection of the main transmission from the engine unloaded the engine and allowed the free turbine to overspeed to more than 150% free turbine rpm, resulting in free turbine blade shedding and loss of engine power. When the main transmission disconnected from the engine, the main rotor rpm immediately began to decay, leaving the pilot no option other than to initiate an autorotation. The low rotor rpm signatures observed at the accident site indicated that the pilot likely autorotated but could not sufficiently arrest the helicopter's vertical descent rate, resulting in a hard impact with terrain.

Given the rough and uneven terrain and the helicopter's low altitude, a successful autorotation landing was improbable. Also, the operator's failure to closely monitor the flight's progress and to make timely inquiries into its whereabouts~~welfare,~~ delayed the search and rescue of the survivor~~ or potential survivors,~~ and likely~~may have~~ added to the severity of his~~their~~ injuries (hypothermia).

~~An examination of the helicopter's engine showed free turbine blade shedding consistent with an engine overspeed.~~ The floor-mounted fuel flow control lever (FFCL) was found captured by fuselage crush in the forward emergency range~~position~~, and the emergency fuel shutoff lever was captured in the aft shutoff position. During impact, the removable acrylic left chin-bubble popped out, and was found about 3 feet in front of the helicopter's nose. A backpack belonging to

the surviving passenger was found between the chin bubble and the nose of the helicopter. All other baggage/cargo was found stowed aft and secured.

~~The rotor system and drive train had damage consistent with impact. No evidence of any preimpact mechanical failures were discovered other than the turbine blade liberations.~~

According to the manufacturer, inadvertent movement of the floor-mounted FFCL~~fuel flow lever~~ into the forward emergency range~~position~~ can cause the engine to overspeed within seconds in certain conditions. Because t~~T~~he FFCL~~fuel flow lever~~ is on the helicopter's cabin floor, situated near the front seat passenger's right foot, and is easily moved with minimal pressure~~,~~ a scenario involving the passenger's foot or his backpack inadvertently moving the FFCL into the emergency range during the flight and causing the engine to overspeed was considered. However, there was no heat damage to the engine's compressor turbine wheels as would be expected due to the excessive influx of fuel into the engine that would immediately result from movement of the FFCL into the emergency range during flight. Further, this scenario does not account for the overtorque damage to the engine's module 5 nut and the engine-to-transmission driveshaft, which had to occur when the engine was producing power (before shedding of the free turbine blades). Therefore, it is not likely that inadvertent movement of the FFCL caused the engine overspeed. Although the reason for the FFCL being in the emergency range could not be determined, it is possible that because it can be easily moved, it was displaced into the emergency range during the impact sequence. ~~In 1994 a Canadian-registered Eurocopter AS-350-B helicopter crashed after a passenger inadvertently moved the floor mounted fuel flow control lever to the closed position while trying to adjust a knapsack. In 1998 an AS-350-B2 crashed in France when a passenger seated on the floor inadvertently moved the fuel flow control lever to the closed position. Two large US helicopter operators also reported information about passengers accidentally interfering with the floor mounted controls.~~

~~As a result of the 1994 crash in Canada, the Canadian Transportation Safety Board (TSB) forwarded an Aviation Safety Information letter to Transport Canada (TC) regarding the possibility of inadvertent manipulation of the fuel flow lever on the AS-350-B helicopter. According to the TSB report, Transport Canada and the industry were investigating the feasibility of installing a control quadrant guard to reduce the likelihood of inadvertent fuel control lever movement. The manufacturer stated that they studied, and proposed, a guard to be installed in a helicopter configuration involving an Emergency Medical Service (EMS) litter installation, but said that due to lack of interest by the operators, the guard was withdrawn as an option in 2007.~~

~~In this accident, due to the close proximity of the passenger's right foot to the unprotected fuel control lever, as well as finding his loose backpack forward of the main wreckage, it is likely that either the passenger's right foot, or his placement of the backpack, inadvertently moved the fuel control lever into the emergency range, resulting in an engine overspeed and loss of engine power. Given the rough and uneven terrain and the helicopter's low altitude, a~~

~~successful autorotation landing was improbable. Also the operator's failure to closely monitor the flight's progress, and to make timely inquiries into its welfare, delayed the search and rescue of the survivor or potential survivors, and may have added to the severity of their injuries.~~

Occurrences

Enroute~~Initial climb~~ – Controlled flight into terrain/obj~~Loss of engine power (total)~~
Autorotation – Collision with terrain/object (non-CFIT)

Findings

1. Aircraft – Aircraft propeller/rotor – Main rotor system – Main rotor blade system – Not specified (Cause)
2. Environmental issues – Physical environment – Terrain – Snowy/icy – Effect on equipment (Cause)
3. Aircraft – Aircraft propeller/rotor – Main rotor drive – Engine/transmission coupling – Damaged/degraded (Cause)
4. Aircraft – Aircraft power plant – Engine (turbine/turboprop) – Turbine section – Damaged/degraded
1. ~~Aircraft – Aircraft power plant – Engine fuel and control – Fuel controlling system – Unintentional use/operation (Cause)~~
2. ~~Aircraft – Aircraft power plant – Engine controls – Power lever – Design (Cause)~~
3. ~~Environmental issues – Task environment – Physical workspace – Access to equipment/controls – Contributed to outcome (Cause)~~
~~4.~~5. Environmental issues – Physical environment – Terrain – mountainous/hilly terrain – Contributed to outcome
5. ~~Personnel issues – Miscellaneous (general) – Passenger~~
6. ~~Personnel issues – Action/decision – Action – Forgotten action/omission – Pilot (Factor)~~
~~7.~~6. Organizational issues – Support/oversight/monitoring – Safety programs – Adherence to safety program – Operator (Factor)

Probable Cause Narrative

An in-flight overtorque of the engine-to-transmission driveshaft resulting in disconnection of the main transmission from the engine. The overtorque likely occurred due to an in-flight main rotor blade contact with snow-covered terrain, precluding significant main rotor blade damage and ground scarring. Contributing to the severity of the surviving occupant's injuries was the helicopter operator's failure to properly monitor their satellite flight-following system and to immediately institute a search once the system reported that the helicopter was overdue.~~The loss of engine power due to an overspeed of the helicopter's turbine engine, precipitated by the inadvertent movement of the fuel flow control lever by the passenger. Also~~

~~causal was the manufacturer's design and placement of the fuel control lever which made it susceptible to accidental contact and movement by passengers. Contributing to the accident was the pilot's failure to properly secure/stow the passenger's backpack. Likely contributing to the severity of the occupant's injuries was the helicopter operator's failure to properly monitor their satellite flight following system and to immediately institute a search once the system reported the helicopter was overdue.~~